Big Rivers
ELECTRIC CORPORATION

Your Touchstone Energy® Cooperative

FACILITY CONNECTION REQUIREMENTS
CMP-FAC-01

NERC Standards:
FAC-001 R1 thru R3

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Introduction

This document has been created to fulfill the requirements listed in NERC Standard FAC-001-0.

Background
In the present electric utility environment characterized by deregulation, open access to the transmission network, wholesale and retail competition, etc., there is wide recognition that electric system reliability, safety and quality of service are to be maintained. Maintaining reliability, safety and quality of service in this changing environment places additional challenges in the planning and operation of electric systems. Each request to connect to the Big Rivers Transmission System will be reviewed to identify the facility impacts and necessary system improvements on the system. These reviews ensure that comparable treatment is given to all users, and that reliability, safety, and quality of service is maintained.

Scope
This document informs entities seeking facility connections to the Big Rivers Transmission System of the connection requirements. The scope of this document is limited to the technical requirements for connected facility design and operation. These requirements do not preclude the need for specific Interconnection Agreements between Big Rivers and entities connecting to the Transmission System.
The scope of this document satisfies the NERC Planning Standards by identifying requirements for connections to the bulk transmission system at voltages generally 100 kV and above. This document may also apply to connections at 69 kV. Requirements applicable for all types of facilities, regardless of voltage level and capacity, are covered. The minimum requirements pertaining to connected facilities are contained herein.
The requirements for initial facility connection apply equally to continued operation of existing connected facilities. Therefore, any upgrades, additions, enhancements, or changes of any kind to an existing connected facility are subject to Big Rivers review to ensure continued compliance with these requirements.
The scope of these documents is limited to the technical requirements for connected facility design and operation. Customers interested in the terms of transmission service should refer to the MISO Open Access Transmission Tariff.
The information contained in this document is supplementary to and does not intentionally conflict with or supersede the National Electric Code (NEC) as approved by the American National Standards Institute (ANSI) or such federal, state and municipal laws, ordinances, rules or regulations as may be in force within the cities, towns or communities in which Big Rivers furnishes electric service. It is the responsibility of the entity connecting with Big Rivers to conform to all applicable national, state and local laws, ordinances, rules, regulations, codes, etc.

Objectives
Big Rivers, in its role as a transmission owner, has prepared this document based on the following objectives:

a) Maintain system reliability, personnel and equipment safety, and quality of service as new facilities are added to the transmission network and existing facilities are modified to meet customer load demands.
b) Ensure comparability in the requirements imposed upon the various entities seeking to connect facilities to the transmission network.
c) Satisfy compliance with NERC Planning Standard FAC-001 the SERC Supplement titled Facility Connection Requirement and its successor SERC Facility Connection Requirements Guideline pertaining to documentation of facility connection requirements by those entities responsible for system reliability.
d) Inform those entities that seek facility connections to the Big Rivers Transmission System of the various requirements for system reliability, safety of personnel and equipment, and quality of service.
e) Facilitate uniform and compatible equipment specification, design, engineering, and installation practices to promote safety and uniformity of service.

Indemnification

The use and reliance upon the information contained in this document shall in no way relieve the Generator, Interconnection, or End-User from the responsibility to meet NEC and NESC requirements governing their design, construction, operation, and materials.

The Requester, for itself, its successors, assigns and subcontractors agrees to pay, indemnify and save Big Rivers, its successors and assigns, harmless from and against any and all court cost and litigation expenses, including legal fees, incurred or related to the defense of any action asserted by any person or persons for bodily injuries, death or property damage arising or in any manner growing out of the use and reliance upon the information provided by Big Rivers. Reliance upon this information shall not relieve the Generator, Interconnection or End-User from responsibility for the protection and safety of the general public.

Legend:

Requirement 1:

Planning

R1. The Transmission Owner shall document, maintain, and publish facility connection requirements to ensure compliance with NERC Reliability Standards and applicable Regional Entity, subregional, Power Pool, and individual Transmission Owner planning criteria and facility connection requirements. The Transmission Owner's facility connection requirements shall address connection requirements for:

R1.1. Generation Facilities,
R1.2. Transmission facilities, and
R1.3. End-User facilities

[VRF – Medium]

Big Rivers Electric Corporation (Big Rivers) has prepared this document which outlines the minimum requirements for all generation facilities, transmission facilities, and end-user facilities connecting to the Transmission System (connecting entity or connecting entities).

This document and all referenced Big Rivers documents are available upon request (within 5 business days) and are available on the Big Rivers page of the MISO OASIS.

Prior to MISO membership, Big Rivers Electric Corporation posted the Facility Connections Requirements on the public OATI OASIS. The document has been modified in the past and a complete revision history documenting the changes is included in the document.

These requirements, as well as the planning procedures and criteria described in Big Rivers document PL-FAC-1, are consistent in content and application to those requirements used by Big Rivers when connecting its own new or modified generation, transmission, or end-user facilities. In addition to the specifics in this document, all connecting entities shall comply with applicable codes, standards (including NERC, SERC, and SERC supplements), federal and state regulations, environmental regulations, siting requirements, contracts, operating agreements, NERC/SERC reporting requirements, and MISO procedures and requirements.

Additional details can be found in the retired Big Rivers document PL-FAC-4: Procedures and Requirements for Adding Generation to Big Rivers' Transmission System, PL-FAC-5: Interconnection and Operating Agreement Template, PL-FAC-1: Transmission Planning Criteria and Guidelines, and the MISO website.

Requirement 2:
Study Procedures, Coordination, and Notification: Planning

R2. *Each applicable Generator Owner shall, within 45 days of having an executed Agreement to evaluate the reliability impact of interconnecting a third party Facility to the Generator Owner's existing Facility that is used to interconnect to the interconnected Transmission systems (under FAC-002-1), document and publish its Facility connection requirements to ensure compliance with NERC Reliability Standards and applicable Regional Entity, subregional, Power Pool, and individual Transmission Owner planning criteria and Facility connection requirements.*

This document applies to Big Rivers as a Transmission Owner and Generator Owner and is intended to fully address the connection requirements for both. However, within 45 days of having an executed Agreement to evaluate the reliability impact of interconnecting a third part Facility to Generation Owner specific facilities, Big Rivers will review these connection requirements. Any changes to these connection requirements that are necessary to properly address the connection request and ensure compliance with NERC Reliability Standards and other applicable standards will be documented and published within the same 45 day window.

Requirement 3:

R3. Each Transmission Owner and each applicable Generator Owner (in accordance with Requirement R2) shall address the following items in its Facility connection requirements:

R3.1. Provide a written summary of its plans to achieve the required system performance as described above throughout the planning horizon:.

R3.1.1. Procedures for coordinated joint studies of new facilities and their impacts on the interconnected transmission systems.

When evaluating connection requests, near-term and longer-term studies are necessary to ensure required system performance is achieved throughout the planning horizon. Studies generally include: short-Circuit (fault duty), stability, power flow, and transfer capability. A detailed discussion of each type of study can be found in the Big Rivers document titled: PL-FAC-1 Transmission Planning Criteria and Guidelines. The criteria and guidelines described in PL-FAC-1 and in this document are intended to ensure required system performance is achieved and all applicable standards (including all TPL standards) are met. Additional study procedures can be found on the MISO website (https://www.midwestiso.org/Planning/). Please refer to both the generation interconnection section as well as the MTEP process. The criteria and guidelines are applied for all studies relating to both internal and external requests for connection and studies performed as part of the normal planning process. A general description of each type of study follows:

<u>Power Flow Studies</u>

Power flow analyses are conducted to examine the impact of the proposed facility on transmission lines and transformers, and voltage profiles. Contingencies consisting of single or multiple outages of lines and/or transformers are considered in these analyses. Where the analyses indicate that transmission upgrades are necessary, alternative plans may be devised and evaluated to accommodate the proposed facility.

<u>Short Circuit Analyses</u>

Short circuit analyses (fault current or fault duty studies) are conducted to examine the impact of the proposed facility on equipment duties. These analyses will be used to determine the impact of the connection (often relating to a generator connection) on the fault duty (i.e., interrupting capability or rating) of previously installed equipment such as circuit breakers or switches. Increased fault duties may require the need to upgrade existing equipment. The study results can also be used to help select the propose size or ratings of the facilities proposed to be connected.

Transient Stability Analyses

A transient stability analysis may be performed to determine the transmission systems' response to a sudden change in the state of the system due to faults on the system and unit outages. Specifically, the analysis will evaluate the transmission system in the area of the added generation as well as the generator's response following faults in the system. Stability studies may also be required to evaluate transmission or end-user connection requests.

Transfer Capability Studies

Transfer studies are often necessary to evaluate all types of connection requests. In general, the impact of the proposed facility on the ability to import and export power is evaluated through power flow studies. Single contingencies are normally evaluated.

Additional Analyses

Other analyses may be required based on power flow analysis and depending on the nature of the proposed connected facility and its location within the transmission network. This could include power quality analyses for End-User load that could potentially cause harmonic current or voltage and/or telephone interference. When adverse sub synchronous torsional interaction is possible (for End-User's equipment such as arc-furnaces and/or cycloconverters to be located in close electrical proximity to existing generation) additional analysis may be required.

Specific Generation Connection Study Procedures & Communication

The Big Rivers document titled: PL-FAC-4 Procedures and Requirements for Adding Generation to the Big Rivers Transmission System was created to describe the various studies and procedures required to evaluate a generation connection request prior to joining the MISO. As the document indicates, a detailed interconnection study generally required the creation of an ad-hoc study group consisting of Big Rivers and potentially impacted neighboring systems. With the integration of Big Rivers into the MISO, generators desiring connection to the Big Rivers system must follow the procedures described on the MISO website https://www.midwestiso.org/Planning/GeneratorInterconnection). The planning project will not typically be included in regional or MMWG models until an Interconnection and Operating Agreement (IOA) is executed. However, it may be necessary to communicate project details prior to this to ensure accurate reliability studies are performed by Big Rivers and other entities. Additional details regarding coordinated study efforts, communication, and notification can be found in the Big Rivers documents titled: PL-FAC-1 Transmission Planning Criteria and Guidelines posted to the Big Rivers page of the MISO OASIS.

Information Required for Transmission or End-User

As soon as available, the entity wishing to connect to Big Rivers shall provide two copies of the following information for review and comment by both the Transmission System Planning and the Transmission System Engineering groups at Big Rivers. Additional information may be required by the MISO.

a) Connecting entity Information – company name, mailing address, contact representative and phone number.

b) Project Design/Engineering Information – company name, mailing address, contact representative and phone number.

c) Requested in-service date for the transmission connection, and a date for temporary service to test facilities prior to formal in-service.

d) Plot plan or description showing exact location and orientation of the proposed facilities and point of electric service delivery.

e) One-line, schematic diagrams, plan and elevation drawings of the proposed facilities showing dimensions, clearances and grounding layout.

f) Information on characteristics of load, including initial load build-up, 5 and 10 year load projections, and power factor of such loads.

g) Information concerning the power factor correction equipment. This information should include size and amount of fixed or switched capacitors, or other power factor correction equipment and methods used for operation.

At least three months before starting electrical construction of the proposed facility, the following additional information must be sent to Big Rivers' Vice-President of System Operations. Failure to provide this information in a timely manner may delay the facility in-service date.

h) Data on equipment to be installed.

i. High side interrupting and sectionalizing devices – Manufacturer, type, voltage rating, and current ratings.

ii. High side relaying equipment – Complete manufacturer's data.

iii. Power transformer – Complete nameplate and test report data, including manufacturer, serial number, high and low side voltage taps, kVA ratings, high and low side connections, low side grounding (if used), load loss watts and positive-and zero-sequence impedances between the high-low, high-tertiary, and low-tertiary transformer windings (as applicable) at each tap.

i) Data on low voltage protection equipment, including fuses, breakers, relays, and relay settings.

The information in subsections h and i is required to perform coordination selectivity studies in a timely manner. Any disagreement in this regard must be resolved prior to energization.

Depending upon the nature of the connecting entity equipment to be installed, the following data may be required to complete the portion of the system impact studies addressing power quality and/or subsynchronous torsional interactions.

j) Data on the harmonic and subharmonic current/voltage spectra of the equipment to be installed under three phase balanced and unbalanced conditions.

k) Maximum magnitudes (MW and MVAr) of sudden load swings at the point of connection and the number of such fluctuations per second, minute or hour.

l) Data on SVC equipment and harmonic filters if applicable.

m) Maximum expected MW and MVAr demand at the point of connection.

<u>Initiating a Transmission or End-User Facility Connection or Facility Change</u>

The following table outlines the Big Rivers personnel to be contacted with regard to any request for a new facility connection or significant change to an existing connected facility.

Type of Customer	Service or Activity	

To be Connected	Required From Big Rivers	Big Rivers Contact
Interconnection	Joint Transmission Planning Studies	Vice President of System Operations
End-User	Initial Contact to Request a Connection or Study	Vice President of System Operations

Following the initial contact regarding a proposed Interconnection or End-User facility connection, when the proposed location and power level are established, a plan of service is prepared and system impact studies are undertaken by Big Rivers. The information needed to develop a plan of service and to conduct the system impact studies is identified in this document and should be provided to Big Rivers at this point. The system impact studies may, as noted above, identify additional requirements for reliability beyond the minimum requirements covered by this document.

Big Rivers approval of a proposed facility or facility change is contingent upon a design review of the proposed connected facility. Operation of a connected facility is also subject to continuing compliance with all applicable construction, maintenance, testing, protection, monitoring, and documentation requirements described herein, as well as the applicable NERC Standards,SERC Documents, and MISO processes (including MTEP) and procedures noted herein. For large loads, interconnects, and other significant connections, an ad-hoc study group may be necessary. This will be determined on a case by case basis.

Interconnection and End-Users may be responsible for the costs associated with connecting to the Big Rivers Transmission System.

The information contained herein is subject to change and may be revised at any time.

Specific Transmission & End-User Study Procedures & Communication

A plan of service is developed to provide for the physical connection between the transmission system and a proposed connected facility. The electrical configuration of the connection equipment including transformers, switchgear and other station equipment, and required transmission line sections are determined. Attachment A illustrates some of the more typical configurations for plans of service, but many other possibilities exist depending on the particular situation at hand. The physical layout of equipment and right-of-way needs are determined in the plan of service as well. A multi-step approach may be considered in the plan of service to accommodate a multi-step increase in load for the connected facility. Normally, the expense of developing a plan of service is the responsibility of the Transmission End-User.

In order to assess the impact of a proposed facility connection on system reliability, system impact studies need to be conducted. These system impact studies, as a minimum, examine the transmission line and transformer loading, voltage profiles and schedules, and power quality impacts of the proposed facility for a range of expected seasonal loading and power transfer conditions. The effect of the proposed facility on short circuit duties is examined for all proposed transmission connections. A multi-step approach to the proposed facility may be considered where the impact of each step is assessed separately.

If the transmission or end-user addition is related to a transmission service request, then MISO tariff provisions and study procedures apply (see MISO website). If the proposed addition is not related to a transmission service request, Big Rivers may first evaluate the request. However, the project will be incorporated into the MISO MTEP process. The system impact studies will be coordinated with neighboring transmission system owners/operators as appropriate. As a minimum, all interconnected neighbors and other impacted parties will be notified of significant transmission system additions or modifications upon execution of an Interconnection and Operating Agreement (or other contract or legal document that indicates the intent to proceed with the system addition or modification). In

addition, significant additions and modifications will be reflected in the power flow models as submitted by Big Rivers to the regional reliability organization. These additions and modifications will also be identified in the regional transmission system assessments as appropriate. More details concerning coordination, study procedures, and criteria used to determine acceptable performance can be found in Big Rivers document PL-FAC-1 and the Planning area of the MISO website.

The scope of all the above system impact studies will be determined by Big Rivers and the MISO based on the type, location, and power level of the proposed facility. The cost of these studies will be chargeable to the Interconnection or End-User in accordance with the MISO Open Access Transmission Tariff. Report(s) documenting the assumptions, results, and conclusions of the system impact studies are made available to the Interconnection or End-User.

Procedures for Notification of New or Modified Facilities **Planning**

R3.1.2. Procedures for notification of new or modified facilities to others (those responsible for the reliability of the interconnected transmission systems) as soon as feasible.

Big Rivers must be notified in writing of new facilities, upgrades, or additions such as an increase in load or generating capability to existing facilities connected to the transmission system within the Big Rivers Balancing area. Notification should be made as soon as possible and prior to the implementation of the change to allow time for the completion of system studies. System impact studies may be conducted to determine the need for any upgrades of transmission equipment or transmission system addition to accommodate the changes in the connected facility. Significant changes shall be reported to MISO via the MTEP process, Coordinated Seasonal Assessment process, or to the RC as appropriate. Additionally, Big Rivers will be notify potentially impacted neighbors of any significant changes when made aware of such change. Big Rivers will ensure all new or modified facilities are included in regional power flow models, short circuit models, and dynamic models through normal regional processes.

Voltage Level and MW and MVAR Capacity/Demand **Planning**

R3.1.3. Voltage level and MW and MVAR capacity or demand at point of connection.

Load Following/Remote Control Functions/Automatic Generation Control (AGC)

Specific provisions for load following and/or remote control functions will be considered on a case-by case basis. When related to a transmission service request, the MISO OATT will apply. If any generator is to provide load following services to Big Rivers, the output must be remotely controllable under direction of the Big Rivers/MISO automatic generation control (AGC) in response to system needs. The generator owner must provide an interface compatible with Big Rivers/MISO AGC control mechanism. Provisions for AGC should be included in an Interconnection Agreement between the connecting entity and Big Rivers. SCADA telemetry will be required to support AGC.

Reactive Power Output and Power Factor

In order to maintain transmission voltages on Big Rivers' transmission facilities within acceptable limits, generating facilities and non-generation resources capable of providing reactive power that are under the control of the balancing area operator must be operated to produce (or absorb) reactive power as required by Big Rivers' transmission facilities. All transmission customers taking service from Big Rivers via the MISO OATT must comply with MISO terms. The amount of reactive supply and voltage control from generation or other sources service that must be supplied with respect to the transmission customer's transaction will be determined based on the reactive power support necessary to maintain transmission voltages within limits that are generally accepted in the region and consistently adhered to by Big Rivers. In general, generating facilities power factor design limitation minimum requirement shall be a reactive power capability sufficient to maintain a composite power delivery at the Points of Interconnection at a power factor between 0.95 leading and 0.95 lagging. Additional MISO conditions may apply.

Capacitor additions at the generator switchyard may be necessary to meet the reactive requirements. The use of capacitors will require specific studies and be evaluated on a case-by-case basis.

In addition, individual generators in the generation facility must make available the full steady-state over- and under-excited reactive capability given by the manufacturer's generator capability curve at any MW dispatch level. This requirement should be considered in all internal generator designs (including transformer ratings/taps/impedances, cooling systems, generator/exciter rating). In general, the generation facility must be capable of continuous non-interrupted operation within a steady-state voltage range during system normal and single facility outage conditions. This range is from 91.7% to 105.8% range.

All reasonable measures should be taken to avoid tripping of the generation facility due to high or low voltage. Specification of the generator voltage schedule will be determined under the direction of the Big Rivers Control Center. A steady-state deviation from this schedule between +0.5% to –0.5% of the nominal voltage will be permissible.

Transmission interconnected equipment shall have the tap ranges and self-regulation necessary to accommodate the transmission system's reactive power flow requirements.

Minimum Operating Capability

The minimum operating capability required will be determined based on limits that are generally accepted in the region and consistently adhered to by Big Rivers.

Black Start Capability

The provision of blackstart capability may be required or desirable. A blackstart capable generation facility is one that can be started without the aid of off-site power supplied from the Transmission System.

Automatic Underfrequency Load Shedding

Big Rivers may require automatic underfrequency load shedding relaying on connected loads to comply with NERC and/or SERC requirements or other system stability considerations. Big Rivers, as a SERC member, is obligated to have an automatic underfrequency load shedding plan in effect that meets SERC requirements. Connecting parties without an automatic underfrequency load shedding plan meeting SERC requirements may need to install underfrequency relaying at the request of Big Rivers. The amount of load to be shed and the frequency setpoints will be specified by Big Rivers as required to meet SERC underfrequency load shedding compliance.

Manual Load Shedding

End-User's facilities may be subject to Big Rivers' Emergency Operating Plan that can require interruption of load to deal with generation deficiencies and/or transmission system emergencies. It is noted that interrupting of load will only be done in extreme conditions that would result in a more serious degradation of system performance than if the load were not shed.

Other Load Shedding

Other load shedding such as over-voltage is not required at this time. However, other automatic load-shedding system may be required in the future.

Power System Stabilizer

Studies may identify the need for the use of power system stabilizers, depending on the plant size, excitation system type and settings, facility location, area transmission system configuration and other factors.

Excitation Control

All generation control system settings should be coordinated with, and approved by, Big Rivers. It may be necessary to coordinate generator settings to ensure proper operation of the Big Rivers underfrequency load shedding program. In addition to the normal excitation system and automatic voltage regulation equipment, the following controls are also required for each synchronous generator.

Overcurrent Limiter: The excitation system is to be provided with a current limiting device which will supersede or act in conjunction with the AVR to automatically reduce excitation so that generator field current is maintained at the allowable limit in the event of sustained under-voltages on the transmission system. This device must not prevent the exciter from going to and remaining at the positive ceiling for 0.1 seconds following the inception of a fault on the power system.

Underexcitation Limiter: A limiter to prevent instability resulting from generator underexcitation is required.

Speed Governing: All synchronous generators shall be equipped with speed governing capability. This governing capability shall be unhindered in its operation consistent with overall economic operation of the generation facility. Overspeed protection in the event of load rejection is the responsibility of the connecting entity.

Sub-Synchronous Torsional Interactions or Resonances: The provision of high speed reclosing following transmission line faults may result in excessive torsional duties. The connecting entity must provide Big Rivers with immunity from damaging torsional oscillations resulting from all Big Rivers Transmission System operations, and insure the turbine-generator is not excited into resonance by normal system operations.

Mode of Frequency/Voltage Control

The connecting entity's generating facility shall operate with its speed governor and voltage regulators in automatic operation. If the connecting entity's speed governor and voltage regulators are not capable of such operation, the connecting entity shall immediately notify Big Rivers.

Speed Droop Setting

The droop setting of any generator connecting to the Big Rivers system will be considered on a case-by-case basis and shall be coordinated with Big Rivers.

Generator Step-Up Transformers

As described in the Big Rivers document titled PL-VAR-1 Voltage and Reactive Control, Big Rivers has the right to require tap changes be made to step-up and auxiliary transformers to ensure voltage schedules and reactive requirements can be met.

Coordination with Appropriate Operating Entity

Any entity connecting to the Big Rivers transmission system must coordinate appropriate data, processes, operating procedures, and any other information as necessary to reliable operate the system and to comply with applicable codes, standards (including NERC, SERC, and SERC supplements), federal and state regulations, environmental regulations, siting requirements, contracts, operating agreements, and NERC/SERC reporting requirements.

Generator Frequency Range

The connecting entity's generating facility will provide a balanced, symmetrical, three phase interchange of electrical power with the Big Rivers Transmission System at a nominal frequency of 60

Hz. The generation facility must be capable of continuous, non-interrupted operation in the frequency range of 59.5 to 60.5 Hz. Limited time, non-interrupted operation is also expected outside this frequency range in accordance with the generator manufacturer's recommendation.

Transmission System Frequency Range

The Big Rivers transmission system typically operates at a nominal 60 Hz with a variation of +0.05 Hz to –0.05 Hz. Under certain emergency conditions, the transmission system may operate for a period of time outside of this range. The Requester is responsible for providing any frequency sensing equipment required to protect their facility during abnormal frequency operation.

Transmission Impacts

All proposed connections shall consider the impact on adjacent areas voltage and reactive power flow requirements. These impacts should be identified in the study process and discussed or coordinated with the potentially impacted system(s). Any additional upgrades required to mitigate these impacts will be the responsibility of the connecting entity.

System Protection/Breaker Duty

Planning

R3.1.4. Breaker duty and surge protection.
R3.1.5. System protection and coordination.

Big Rivers will provide functional specifications of the relay protection on their terminal in order for the Requestor's protection to match. Big Rivers will review Requestor's facility relay settings for coordination with the Big Rivers system protection that have a potential impact on the reliability of the Big Rivers Transmission System or the bulk electric system. The criteria for these functional specifications and settings will be based on existing Big Rivers' protection practices. Big Rivers reserves the right to specify the type and manufacturer for these protective relays. The specific recommendations and requirements for protection will be made by Big Rivers based on the individual substation location, voltage and configuration. While Big Rivers will endeavor, where possible, to anticipate system changes which may affect system protection needs and requirements, Big Rivers does not assume responsibility or liability with respects to such protective devices nor guarantee their continuing adequacy against increased interrupting capacity requirements resulting from system changes. Any equipment replacements or upgrades to maintain adequacy of the protection system will be at the requestor's expense.

The resulting system protection system must provide the highest level of public safety possible and prevent or minimize equipment damage with existing and future fault levels. The protection system should be designed to minimize equipment outage time, to minimize the outage area, and to minimize system voltage disturbances.

All protection system requirements, including maintenance and testing, apply to equipment used for protecting the system during normal and abnormal conditions.

To ensure the proper design of the protection system, system studies and other analyses will be necessary prior to placing any new facilities in service. These studies may include grounding, short circuit, stability, power quality, and coordination of protective devices. These studies will be performed by Big Rivers or under the direction of Big Rivers. In general, three phase and single line to ground fault studies will be completed for all generation additions, transmission additions, and significant end-users additions. The purpose of these studies is to identify protection equipment that may need to be upgraded or replaced as a result of connections. All protection equipment must be within the established ratings as described in the facility rating methodology documentation maintained by Big Rivers. The studies will also provide the expected maximum fault currents for use in the design of facilities to be owned and/or operated by the requestor. The requestor shall design its protection system to be within all applicable facility ratings. The cost of new facilities and any required changes to existing facilities due to increased fault current will typically be the responsibility of the requestor. Specific communication and RTU information can be found in Section 5.0.

System Protection

The connecting entity is responsible for providing adequate protection to Big Rivers' facilities for conditions arising from the operation of the connecting entity's facilities under all Big Rivers transmission system operating conditions. The requester is also responsible for providing adequate protection to their facility under any Big Rivers transmission system operating condition whether or not their generation/transmission/end-use facility is in operation. Conditions may include but are not limited to:

1. single phasing of supply,
2. transmission system faults,
3. equipment failures,
4. abnormal failures,
5. lightning and switching surges,
6. excessive harmonic voltages,
7. excessive negative sequence voltages,
8. separation from supply,
9. synchronizing generation,
10. re-synchronizing the Owner's generation after electric restoration of the supply.

Interrupting Device

All generation and transmission connecting entities shall provide a three-phase circuit breaker with appropriate relaying systems to isolate the facilities from the Big Rivers supply for all faults, loss of Big Rivers supply, or abnormal operating conditions regardless of whether or not the connecting entity's facility is in operation. Circuit breaker requirements for end-users will be determined on an individual case-by-case basis. All generator, transmission, and end-users connected to a Big Rivers substation will be responsible for the costs necessary to expand the Big Rivers owned substation and provide the necessary circuit breakers and protection equipment consistent with the designs used by Big Rivers when expanding its own system.

This device shall be capable of interrupting the maximum existing and future available fault current at that location. The three-phase device shall interrupt all three phases simultaneously. The tripping control of the circuit interrupting device shall be powered independently of the utility AC source in order to permit operation upon loss of the Big Rivers transmission system connection.

The specific reclosing times for the connecting entity's circuit interrupting device will be provided by Big Rivers. It is the connecting entity's responsibility to design and maintain their interrupting device(s) to properly isolate their facility upon loss of the Big Rivers connection until the appropriate Big Rivers facilities are returned to service.

Synchronizing of generation to the Big Rivers Transmission System may be, at Big Rivers' discretion, performed under the direction of the Big Rivers Control Center. All manual or automatic synchronization must be supervised by a generator sync check relay. In addition, sync scopes are required at all transmission substations and generation switchyard to allow reconnection of islanded areas.

Disconnecting Devices

A group operated switch shall be installed on each transmission line supply entrance to the Requester's facility and accessible to Big Rivers' personnel at all times. The switch shall be mechanically lockable in the open position with a Big Rivers padlock in order to provide for a visible electric isolation of the Requester's facility and shall be identified with a Big Rivers designated equipment number.

All air break switches shall be three phase, single throw, group operated. Disconnect switches shall be three pole, single throw, group operated. Characteristics for all air break switches and disconnect switches including voltage and BIL ratings, clearances and pole spacing shall meet the requirements shown in the table in Attachment B and shall be capable of withstanding momentary fault current. Facilities in areas with significant airborne pollution may require a higher BIL level. These shall be no braids in the current carrying parts of the switch. Group operated switches shall be complete with a horizontal, rotating-type operating handle. A grounding device is to be furnished for the operating shaft and shall consist of a tin coated, flexible copper braid, located as close as possible to the operating handle. The braid shall have a cross-sectional area equivalent to 4/0 copper cable, or greater. The braid shall be secured to the shaft by means a galvanized steel U-bolt clamp and associated cradle-type galvanized steel hardware. The opposite end of the braid shall have two (2) 9/16 inch holes at 1-3/4 inch spacing. Both ends of the braid shall be stiffened and protected by a ferrule or additional tinning.

As a minimum, a protective grounding loop shall be provided for switches as illustrated in Attachment B. This table applies to areas where native soil resistivity does not exceed 500 Ohm-meters. When the above condition is exceeded a detailed engineering assessment study must be undertaken by Big Rivers.

All workers who are using the operating handles on air break switches and disconnects on energized lines and equipment shall use protective headgear, insulating gloves, approved protective footwear and arc flash protector. Before operating, the switch and ground arrangement shall be visually checked.

All switches are to be manufactured and tested in accordance with the latest revision of ANSI C37.30, ANSI C37.32, and ANSI C37.34.

Parallel Generation Facility

The following utility-grade relays shall be provided by the connecting entity for protection of the Big Rivers system.

All relays specified for the protection of the Big Rivers system, including time delay and auxiliary relays, shall be approved by Big Rivers. Relay operation for any of the listed functions shall initiate immediate separation of the connecting entity's generation from the Big Rivers Transmission System.

Relay	**Function**
Frequency	To detect under frequency and over frequency operation.
Overvoltage	To detect overvoltage operation.
Undervoltage	To detect undervoltage operation.
Ground Detector	To detect a circuit ground on the Big Rivers system (applicable to three-phase circuits only).
Directional Overcurrent	To detect the directional flow of current in excess of a desired limit.
Transfer Trip Receiver	To provide tripping logic to the generation for isolation of the generation upon opening of the Big Rivers supply circuits.

Directional Power	To detect under all system conditions, a loss of Big Rivers primary source. The relay shall be sensitive enough to detect transformer magnetizing current supplied by the generation.

The purpose of these relays is to detect the connecting entity's energization of a Big Rivers circuit that has been disconnected from the Big Rivers system, to detect the generation operating at an abnormal voltage or frequency, or to detect a fault or abnormal condition on the Big Rivers system for which the connecting entity shall separate their generation.

Output contacts of these relays shall directly energize the trip coil(s) of the generator breaker or an intermediate auxiliary tripping relay which directly energizes the breaker trip coil(s). The relaying system shall have a source of power independent from the AC system or immune to AC system loss or disturbances (e.g., DC battery and charger) to assure proper operation of the protection scheme. Loss of this source shall cause removal of the generation from the Big Rivers system.

The protective relays required by Big Rivers and any auxiliary tripping relay associated with those relays shall be utility-grade devices.

Utility grade relays are defined as follows:

1. Meet ANSI/IEEE Standard C37.90, "Relays and Relay Systems Associated with Electric Power Apparatus."

2. Have relay test facilities to allow testing without unwiring or disassembling the relay.

3. Have appropriate test plugs/switches for testing the operation of the relay.

4. Have targets to indicate relay operation.

Big Rivers will specify settings for the Big Rivers-required relays to assure coordination between the generation protective equipment and the Big Rivers system relays. It is the connecting entity's responsibility to determine that their internal protective equipment coordinates with the required Big Rivers protective equipment and is adequate to meet all applicable standards to which the generation is subject. Big Rivers further reserves the right to modify relay settings when deemed necessary to avoid safety hazards to utility personnel or the public and to prevent any disturbance, impairment, or interference with Big Rivers' ability to serve other connecting entities.

Big Rivers Facilities

If at any time it is determined that the use of the above relay systems cannot provide adequate protection to the Big Rivers system, the connecting entity shall furnish and install upon the request of Big Rivers, a transfer trip receiver(s) at its facility to receive tripping signals originating from a Big Rivers location(s). This additional protection would also necessitate the purchase and installation of transfer trip equipment at the Big Rivers' location(s) and a communication channel between the Big Rivers location(s) and the generation facility.

Other Protection Requirements

The following items should be coordinated with each other.

- Volts/Hz and overexcitation protection/limiting.

- Loss-of- excitation and underexcitation limiting.

Any required remote trip schemes must be closely coordinated and approved by Big Rivers. In addition, underfrequency load shedding schemes, under voltage load shedding schemes, and/or special protection schemes may be required to meet NERC, SERC, or other regulatory requirements. Any such protection scheme will require close coordination with Big Rivers as well as Big Rivers approval prior to placing any such facilities in service.

Short Circuit Data & Interrupting Device Ratings

The following estimated short circuit levels will be provided by Big Rivers at the point of delivery.

Estimated Initial Short Circuit Levels (Year)

3 Phase Fault = _____MVA ANSI X/R Ratio = _____

Phase-to-Ground Fault* =_____ MVA ANSI X/R Ratio = _____

Estimated Future Short Circuit Levels (Year)

3 Phase Fault = _____MVA ANSI X/R Ratio = _____

Phase-to-Ground Fault*=_____ MVA ANSI X/R Ratio = _____

**Note: Phase-to-ground fault values are calculated assuming the Requester's transformers have either an ungrounded-wye or delta connected high side. For wye-grounded transformers, the transformer contribution to the total fault current will have to be taken into account and the fault values recalculated.*

Interconnection and End-Users equipment should have adequate interrupting and momentary ratings for the existing and future short circuit conditions listed above.

While Big Rivers will endeavor, where possible, to anticipate system changes which may affect these values, it does not assume responsibility or liability with respects to such protective devices, nor guarantee their continuing adequacy against increased interrupting capacity requirements resulting from system changes. Interconnection and End-Users who use this information should periodically review existing and future fault conditions and equipment ratings for adequacy. Any equipment replacements or upgrades to maintain adequacy of the interconnection or end-users' facilities will be at the interconnection or end-users' expense.

All gas insulated protective devices within the Requester's facility having a direct connection to a Big Rivers transmission line shall be equipped with a low gas pressure alarming/tripping/lockout scheme as appropriate for the particular device.

Surge Protection (Lightning Arresters)

Lightning arresters protecting transformers are generally mounted on the transformer tank. However, since lightning arresters can adequately protect equipment some distance from the arresters, the overall number of lightning arresters required in each design can be reduced. Lightning arrester allowable separation distance from the equipment being protected is based on Table 4 of IEEE Std. C62.22. Consult manufacturer's catalog for details concerning arrester protective characteristics, ratings, and application. Lightning arresters for transformer protection are to be rated station class.

Lightning arresters shall be mounted on the incoming line terminal. Application of the arresters shall be coordinated with the insulation level of incoming line and station equipment. Lightning arresters for incoming line protection are to be rated station class..

Metering and Telecommunications **Planning**

R3.1.6. Metering and telecommunications.

Voice Communication Circuit - Generator

The connecting entity will be required to establish a dedicated voice communication circuit to the Big Rivers Control Center to permit coordination of the synchronization and operation of the generation.

Voice Communications - General

Normal – At Big Rivers' request, the connecting entity shall provide a dedicated voice communication circuit to the Big Rivers Control Center. Such a dedicated voice communication circuit would originate from the connecting entity's office staffed 24 hours a day and would be typically required for generation facility synchronization and operation within Big Rivers' Balancing area.

All other normal voice communication concerning facility operations shall be conducted through the public telephone network to the Control Center phone number(s) issued by Big Rivers.

Emergency – Voice communication in the event of a transmission system or energy emergency shall use the dedicated voice circuits, or public telephone network and phone number(s) designated for emergency use.

In the event of a transmission system or energy emergency, the connecting entity may be notified by the Big Rivers Control Center. Specific instructions may also be given regarding the operation of the connecting entity's unit(s) depending on the nature of the emergency. These instructions may consist of voltage schedule changes, real and/or reactive dispatch changes, or instructions to shut down or start-up the Owner's unit(s). It is the Owner's responsibility to ensure that the unit operators follow all instructions given by the Big Rivers Control Center during system emergencies.

At the discretion of Big Rivers, generation control facilities and supervisory control and data acquisition of specific electrical devices from the Big Rivers Control Center may be necessary to integrate the generation into Big Rivers' balancing area. Such additional facilities, including required communication channels, shall, if required, be furnished and installed by the connecting entity.

The requirement for data acquisition and control will depend on the generation capacity or load size, system location, and voltage of connection, and the net generation input into Big Rivers System. In all cases, the equipment shall allow Big Rivers to meet all industry standards that apply to Big Rivers as a balancing authority, transmission planner, transmission owner and operator and any other applicable classification.

Data acquisition and control information will typically include, but not be limited to:

1. desired generation MW set point,

2. automatic generation control status (on,off),

3. generator availability,

4. generation MW, Mvar output,

5. generator minimum and base MW capability,

6. generator MW AGC high limit and low limit,

7. connection facilities' breaker status/control/alarms,

8. connection facilities' MW and Mvar line values and bus voltage, and generator and substation metering (MWh) data.

9. voltage

<u>Revenue Metering</u>

Big Rivers approved revenue class metering equipment shall be installed to meter the aggregated load of the connected facility consisting of instantaneous bi-directional real and reactive power and integrated hourly real and reactive energy metering.

The metering equipment will include potential and current transformers, meters and test switches. The metering equipment will be tested periodically as defined in the service agreement and the test

results will be available to all involved parties. The meters, test switches and wiring termination equipment will be sealed and the seal may be broken only when the meters are to be tested, adjusted or repaired. Proper authorities from both parties will be notified when seals are broken.

Three metering elements will be used to measure all real and reactive power crossing the metering point. Bi-directional energy flows including watt-hour and var-hour will be separately measured on an hourly basis. Appropriate demand quantities will be metered in terms of kilowatts, kilovars, or kilovolt-amperes. The meters will have a separate register for loss compensation. If required, voltage measurements will be provided.

The instrument transformers used for revenue metering shall be installed on the high voltage side of the Requester's step-down transformer. Under special circumstances and with written approval granted by Big Rivers, revenue metering may be performed on the low voltage side of the step-down transformer.

Written approval shall only be given if the Requester can demonstrate that accurate transformer loss compensation will be programmed into the revenue metering when instrument transformers are installed on the low voltage side of the step-down transformer.

Either party may own the metering if the connection is a transmission interconnection with another utility. For any connection that is a generator or load, Big Rivers will retain ownership of the metering facilities and must be sealed or protected against access by others.

Telemetry

Suitable telemetry equipment will be installed at the metering point to provide real-time telemetry data to Big Rivers and to all other participating parties.

Telemetry equipment will include transducers, remote terminal units, modems, telecommunication lines, and any other equipment of the same or better function. The remote terminal unit, or equivalent device, must have multiple communication ports to allow simultaneous communications with all participants. That device will accommodate data communication requirements specified by each host system, including communication protocol, rate and mode (either synchronous or asynchronous). All metered values provided to the telemetry equipment will originate from common metering equipment. All transducers used for telemetry will have at least 0.2 percent accuracy. As part of real-time data to be provided, Big Rivers has the right to require the status and remote control of switching devices at the Receipt and/or Delivery Points.

A continuous, accumulating record of megawatt-hours and megavar-hours will be provided by means of the registers on the meter. Freezing accumulation data transmission will be taken every clock hour. The freezing signals must be provided by only one agreed-upon party.

If the freeze signal is not received within a predefined time window, the remote terminal unit, or equivalent device, will be capable of freezing data with its own internal clock.

The metering, if external power supply is required, and telemetry equipment will be powered from a reliable power source, such as a station control battery, in order to allow the equipment to be continuously operational under any abnormal power supply situations. Proper surge protection will be provided for each communication link to protect communication hardware from ground-potential-rise due to any fault conditions. When real-time telemetry is required, a back-up data link must be provided in case of the outage of the primary telemetry line. The back-up link can be a data communication link between involved control centers; the party requesting service is responsible for furnishing the back-up link.

Additional Metering and SCADA Information

Requirements for data protocol, the mode of data transmission (e.g. fiber optic, microwave, etc.), control functionality, and maintaining continuity (dual DC sources, dual port RTU, etc) pertaining to metering and SCADA will be determined on a case-by-case basis by Big Rivers. Any requirements

imposed by Big Rivers will not exceed those imposed for internal Big Rivers projects unless special reliability or regulator requirements necessitate more stringent requirements. Additional meter information and requirements for generator connecting to the Big Rivers transmission system is contained in the Big Rivers interconnection and operating agreement template titled PL-FAC-5 Interconnection and Operating Agreement.

Grounding and Safety Issues

Planning

R3.1.7. Grounding and safety issues.

All work performed by an entity connecting to the Big Rivers transmission system that may reasonably be expected to affect Big Rivers shall be performed in accordance with Prudent Utility Practice and all applicable laws, regulations, and other requirements pertaining to the safety of persons or property. A Party performing work within the boundaries of the other Party's facilities must abide by the safety rules applicable to the site.

The connecting entity shall notify Big Rivers, first orally and then in writing, of the release of any Hazardous Substances, any asbestos or lead abatement activities, or any type of remediation activities, each of which may reasonably be expected to affect Big Rivers, as soon as possible but not later than twenty four (24) hours after the entity becomes aware of the occurrence, and shall promptly furnish to Big Rivers copies of any reports filed with any governmental agencies addressing such events.

System Grounding

The specific grounding of the connecting entity's system at the transmission voltage level will be considered on a case-by-case basis. Grounding studies will be necessary and shall be provided to Big Rivers. This is intended to ensure compatibility with the Big Rivers system and connection of the grounding systems. In general, the grounding system should be designed in accordance with IEEE Standard 80 – latest revision, "IEEE Guide for Safety in AC Substation Grounding." In evaluating the step and touch potential the target body weight value should be set to 50 kg. If a reasonable grounding design is unobtainable using 50 kgs, then consider a body weight of 70 kg as the absolute minimum allowable.

If the facility structure is to be wood-pole type construction, the transmission line overhead ground wire, all switch bases, fuse bases, and other noncurrent-carrying metal parts shall be grounded to the station grid.

Specifics regarding maintenance/testing, construction techniques and inspections, transmission shielding, cathodic protection, and other items will be considered on a case-by-case basis.

Facility Fence Safety Clearances

The fence safety clearances in the Requester's facility shall comply with Section 11 of ANSI C2-1997, "National Electrical Safety Code."

Switching

All personnel who are using the operating handles on air break switches and disconnects on energized lines and equipment shall use the appropriate personal protection equipment as required by all applicable regulatory bodies and safety procedures. Before operating, the switch and ground arrangement shall be visually checked.

Insulation and Insulation Coordination

Planning

R2.1.8. Insulation and insulation coordination.

All designs and specification shall be submitted to Big Rivers for review. Specific design parameters (shielding, attachment details, surge protection, etc.) will be considered on a case-by-case basis. Additional specifics follow:

Equipment Basic Insulation Levels

The minimum required Basic Insulation Levels (BIL) for stations are listed in Table 1 of Attachment B. Facilities in area with significant airborne pollution may require a higher insulation level. Insulation coordination shall be reviewed for overvoltage protection of station and line equipment.

Insulators for Station

The required station post insulator types are listed in the table in Attachment B. Facilities in areas with significant airborne pollution may require a higher insulation level. Higher strength insulators are available and should be used if needed to meet bus momentary short circuit withstand values.

Voltage, Reactive Power, and Power Factor Control **Planning**

R3.1.9. Voltage, Reactive Power, and power factor control.

Voltage Range - Generator

In general, the generation facility must be capable of continuous non-interrupted operation within a steady-state voltage range during system normal and single facility outage conditions. This range is from 92% to 105% range. All reasonable measures should be taken to avoid tripping of the generation facility due to high or low voltage. Specification of the generator voltage schedule will be determined under the direction of the Big Rivers Control Center. A steady-state deviation from this schedule between +0.5% to –0.5% of the nominal voltage will be permissible.

Voltage Range – Transmission and End-User

All connected facilities on Big Rivers Transmission System should expect voltage levels which generally under system normal conditions and single transmission element outage conditions range between 92% and 105% of nominal. If the Requester's supply voltage requirements are more restrictive than the 92% to 105% range, Big Rivers recommends that the Requester consider the addition of voltage regulation equipment in their facility. Nominal transmission system voltages presently on the Big Rivers system are: 345 kV, 161 kV, 138 kV, and 69 kV.

Under certain emergency conditions, the Big Rivers Transmission System may operate for a period of time outside of the 92% to 105% range. The Requester is responsible for providing any voltage sensing equipment required to protect their equipment during abnormal voltage operation.

Transmission interconnected equipment shall have the tap ranges and self-regulation necessary to accommodate the transmission system's reactive power flow requirements.

Net Demonstrated Real and Reactive Capabilities

The Net Demonstrated real capability in accordance with NERC standards and SERC supplements or guidelines, must be provided to Big Rivers annually. Big Rivers reserves the right to witness these tests.

In addition, individual generators in the generation facility must make available the full steady-state over- and under-excited reactive capability given by the manufacturer's generator capability curve at any MW dispatch level. This requirement should be considered in all internal generator designs (including transformers, tap settings, motor and other loads, generator/exciter, voltage regulator). Tests which demonstrate this capability must be conducted in a manner and frequency that is in accordance with NERC standards and SERC supplements or guidelines. Such documentation shall be provided to Big Rivers. Big Rivers reserves the right to witness these tests.

Reactive Compensation

A circuit should be provided in the automatic voltage regulator (AVR) to permit the control of voltage beyond the generator terminals. This is known as reactive line drop compensation. The point of control is to be adjustable over a range covering 0 to 15% reactance (on the generator base) beyond the generator terminals. The specific requirements for reactive compensation, voltage regulator droop compensation for generators whose terminals are directly connected, and voltage regulators

will be considered on a case-by-case basis. In general, any reactive compensation devices will be evaluated to ensure proper coordination with the Big Rivers system.

Power Factor

The NERC Planning Standards state that distribution entities and customers connected directly to the transmission systems should plan and design their systems to operate at close to unity power factor to minimize the reactive power burden on the transmission systems. The Big Rivers interpretation of "close to unity power factor" is that the power factor of the connected load should be within the range of approximately 0.90 lagging to 0.90 leading. The generating facility power factor design limitation minimum requirement shall be a reactive power capability sufficient to maintain a composite power delivery at the Points of Interconnection at a power factor between 0.95 leading and 0.95 lagging.

An End-User will be assessed a penalty for power factors below 90% (leading or lagging) at the time of the end-user peak demand.

Capacitors generally provide an effective means of controlling the power factor of a Requester's facility. However, there are several factors that should be addressed in applying capacitors. These factors can include, but are not limited to, transient voltages due to capacitor switching and voltage amplification due to resonance conditions. The services of a qualified consultant should be obtained to review the specific application and provide recommendations in regard to control of these phenomena.

Mode of Frequency/Voltage Control

The connecting entity's generating facility shall operate with its speed governor and voltage regulators in automatic operation. If the connecting entity's speed governor and voltage regulators are not capable of such operation, the connecting entity shall immediately notify Big Rivers.

Power Quality Impacts

Planning

R3.1.10 Power quality impacts.

In general, the connection of a generator, transmission facility, or end-user shall not unacceptably compromise or degrade the power quality of an existing customer. The installation of power quality monitoring equipment by Big Rivers at the requestor's expense may be necessary to verify compliance with power quality performance requirements. Prior to connection of any facilities, Big Rivers may require, at the requestor's expense, a power quality study. A power quality study may include studies/evaluations of: voltage unbalance, voltage flicker, voltage fluctuation, harmonic distortion, transient overvoltage, temporary overvoltage, temporary under voltage, insulation coordination, operating frequency, power factor range, and interruption/outage frequency. The studies may identify the need for additional equipment necessary to meet power quality standards. Additional specifics follow:

Harmonics/Voltage Flicker

Generators: The connecting entity shall take responsibility for limiting harmonic voltage and current distortion caused by their generation equipment. Limits for harmonic distortion (including inductive telephone influence factors) are consistent with those published in the latest issues of ANSI/IEEE 519, "Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems." Big Rivers may require the installation of a monitoring system to permit ongoing assessment of compliance with these criteria.

The generator's facilities and equipment shall not cause excessive voltage flicker nor introduce excessive distortion to the sinusoidal voltage or current waves as defined by ANSI Standard C84.1 1989, or any applicable superseding electric industry standard. For voltage flicker in the frequency range of 1 to 25 Hz, voltage flicker levels are unacceptable if either of the following conditions exist: (a) the cumulative RMS voltage flicker at the Points of Interconnection exceeds 0.30% for 1.0% of a representative time period, or (b) the instantaneous voltage flicker level regularly exceeds 0.45% at

the Points of Interconnection (this is approximately equal to a cumulative RMS voltage flicker of 0.45% for 0.01% of a representative time period.)

End-Users: Certain electrical equipment located at the End-User's facility (arc furnaces, cycloconverters, etc.) will generate voltage flicker and harmonic distortion which can negatively impact other End-Users. Should this be the case, the End User shall take responsibility, initially or in the future, for limiting interfering levels of harmonic voltage and current distortion and/or voltage flicker. Limits for harmonic distortion (including inductive telephone influence factors) are as published in the latest issues of ANSI/IEEE 519, "Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems."

Big Rivers may, initially or in the future, require the installation of a monitoring system to permit ongoing assessment of compliance with these criteria. The monitoring system, if required, will be installed at the End-User's expense.

Subsynchronous Torsional Interaction

Certain End-User equipment, in particular electric arc furnaces and cycloconverters, may cause adverse interactions and possible damage to existing turbine-generators located in close electrical proximity. These situations will be analyzed by Big Rivers, or Big Rivers consultant, and appropriate corrective or preventive measures identified as needed. Corrective and preventive measures may consist of torsional current monitoring at a defined point of compliance, special protective relaying on the turbine-generator shafts(s), or constrained operation of the End-User equipment under certain system configurations. Costs of studies and the design and installation of protective and/or monitoring equipment shall be the responsibility of the Requester.

Situations where high harmonic voltages and/or currents originate from transmission system are to be addressed in the Connection Agreement.

Sensitive Electrical Equipment

Certain electrical equipment in the Requester's facility may be sensitive to normally occurring electric interference from nearby connected loads in the Requester's facility, from other End-Users connected to the power system, from natural causes, and system switching, etc. If sensitive electrical equipment is to be supplied directly from the electric power system, it is recommended that the equipment grounding requirements and power supply requirements be examined by the Requester or the Requester's consultant prior to installation. Attention should be given to equipment tolerance to various forms of electric interference, including voltage sags and surges, momentary outages, transients, current and voltage harmonic distortion, or other electrical and electromechanical noise.

When electrical disturbances to sensitive electrical equipment such as computers, electronics, controls and communication equipment cannot be tolerated, the End-User shall install additional equipment as may be necessary to prevent equipment malfunctions and protect against equipment failure. The End-User should consult the supplier of such sensitive electrical equipment regarding the power supply requirements or the remedial measures to be taken to alleviate potential misoperation or failure of the equipment. The End-User may need to hire a power quality consultant to also perform a site survey of the electric power supply environment and furnish recommendations to provide the acceptable levels of reliability and quality of service.

Equipment Ratings

Planning

R3.1.11 Equipment Ratings.

As with all design elements that have the potential to impact the transmission system, Big Rivers has the right to review the facility design and specifications prior to the connection to the Big Rivers transmission system.

In most cases, the cost of any changes to the existing transmission system that are necessary due to the requestors project will be the responsibility of the requestor.

Size and Take-Off Tension of Line Conductors and Overhead Ground Wires

The Requester's structure shall be designed in accordance with Rule 250 of the National Electric Safety Code (NESC). The specific take-off tensions, number of overhead ground wires, and wire sizes will be determined on a case-by-case basis.

The line terminal connectors furnished by the Requester should be aluminum conductor with a bolted connector compatible with Big Rivers' terminal pad. The overhead ground wire shall be grounded using copper conductor connected to the ground grid.

If the incoming high voltage lines will cross road ways or railroad tracks, such as a siding or main line, to reach the Requester's facility, it may be necessary to increase the above tensions or provide additional height on the structure to meet appropriate crossing requirements.

The point of attachment of the line entrance conductors shall be of sufficient height to provide the basic vertical clearance requirements for lines crossing over public streets, alleys, or roads in urban or rural districts, as outlined in the NESC.

Ratings of Current Carrying Equipment

For tap and looped connections, the Requester's high voltage bus and associated equipment, such as switches, circuit breakers, connectors, and other conductors shall have a minimum continuous current and momentary asymmetrical current ratings which: (1) do not limit the Big Rivers Transmission system network capability and (2) have adequate capability for the initial and future system conditions identified by Big Rivers.

Transformer Surge Protection (Lightning Arresters)

Lightning arresters protecting transformers are generally porcelain design and mounted on the transformer. However, since lightning arresters can adequately protect equipment some distance from the arresters, the overall number of lightning arresters required in each design can be reduced. Lightning arrester allowable separation distance from the equipment being protected is based on Table 4 of IEEE Std. C62.22.

Consult manufacturer's catalog for details concerning arrester protective characteristics, ratings, and application.

Electrical Clearances (Outdoor)

Electrical facility design clearances are listed in the table in Attachment B. These design clearances should be used for electrical facilities up to and including any interrupting device connected directly to a Big Rivers transmission line and for all facilities that are part of the Big Rivers transmission current path.

The minimum vertical clearance of the conductors above ground and the vertical and horizontal clearance of conductors passing by but not attached to a building or wall shall be in accordance with the NESC or applicable state and local codes.

Air Break Switch(es) and Disconnect Switch(es)

A group operated switch shall be installed on each transmission line supply entrance to the Requester's facility and accessible to Big Rivers' personnel at all times. The switch shall be mechanically lockable in the open position with a Big Rivers padlock in order to provide for a visible electric isolation of the Requester's facility and shall be identified with a Big Rivers designated equipment number.

All air break switches shall be three phase, single throw, group operated. Disconnect switches shall be three pole, single throw, group operated. Characteristics for all air break switches and disconnect switches including voltage and BIL ratings, clearances and pole spacing shall meet the requirements

shown in the table in Attachment B. Facilities in areas with significant airborne pollution may require a higher BIL level. These shall be no braids in the current carrying parts of the switch. Group operated switches shall be complete with a horizontal, rotating-type operating handle. A grounding device is to be furnished for the operating shaft and shall consist of a tin coated, flexible copper braid, located as close as possible to the operating handle. The braid shall have a cross-sectional area equivalent to 4/0 copper cable, or greater. The braid shall be secured to the shaft by means a galvanized steel U-bolt clamp and associated cradle-type galvanized steel hardware. The opposite end of the braid shall have two (2) 9/16 inch holes at 1-3/4 inch spacing. Both ends of the braid shall be stiffened and protected by a ferrule or additional tinning.

As a minimum, a protective grounding loop shall be provided for switches. Under certain conditions, a detailed engineering assessment study may be necessary. This will be determined on a case-by-case basis.

All switches are to be manufactured and tested in accordance with the latest revision of ANSI C37.30, ANSI C37.32 , and ANSI C37.34.

Other Considerations

Special considerations for specific atmospheric, geological, seismic, or environmental conditions will be evaluated on a case-by-case basis.

Synchronizing of Facilities

Planning

R3.1.12 Synchronizing of facilities.

Synchronization

The connecting entity shall assume all responsibility for properly synchronizing their generation for operation with the Big Rivers Transmission System. Upon loss of the Big Rivers supply, the connecting entity shall immediately and positively cause the generation to be separated from the Big Rivers system. Synchronizing procedures are to be approved in advance by Big Rivers and must be strictly followed during all manual and automatic synchronizing operations. Specific technical criteria controlling the synchronized closing operation and operator functions shall be incorporated into these procedures. Synchronizing of generation to the Big Rivers Transmission System may be, at Big Rivers' discretion, performed under the direction of the Big Rivers Control Center though normal voice communication consistent with procedures described in Section 15. All manual or automatic synchronization must be supervised by a generator sync check relay. Application, settings, and device selection shall be approved by Big Rivers for all synchronizing equipment. In addition, sync scopes are required at all transmission substations and generation switchyard to allow reconnection of islanded areas.

Automatic transmission line reclosing must be coordinated with, and approved by, Big Rivers. Specific prohibitions for reclosing will be determined on a case-by-case basis.

Test plans must be consistent with NERC and other regulatory standards and provided to Big Rivers for review and approval.

Maintenance Coordination

Planning

R3.1.13 Maintenance coordination.

All Requester owned equipment up to and including the first protective fault interrupting device is to be maintained and calibrated to NERC and Big Rivers standards. The maintenance practices of all entities connected to the Big Rivers transmission system should be performed at a level that ensures the reliability and continuity of service to the interconnected transmission system. Relevant maintenance records must be maintained. This may include transmission facilities, generation equipment, transformers, circuit breakers, circuit switchers, power fuses, instrument transformers, switches, surge arresters, bushings, metering, communication equipment, trip circuits, interrupters, grounding systems, relays, and associated equipment (including battery and battery charger). Details of Big Rivers maintenance procedures will be provided on requested.

The Requester shall have an organization approved by Big Rivers test and maintain all devices and control schemes provided by the Requester for the protection for the protection of the Big Rivers system. Included in the testing and maintenance will be any initial set up, calibration, and check out of the required protective devices, periodic routine testing and maintenance, and an testing and maintenance caused by a Requester or Big Rivers change to the protective devices.

If the Requester's testing and maintenance program is not performed in accordance with Big Rivers' Standards, Big Rivers reserves the right to inspect, test, or maintain the protective devices required for the protection of its system.

All costs associated with the testing and maintenance of devices provided by the Requester for the protection of the Big Rivers system, including costs incurred by Big Rivers in performing any necessary tests or inspections, shall be the responsibility of the Requester.

Big Rivers reserves the right to approve the testing and maintenance practices of a Requester when the End-User's system is operated as a network with the Big Rivers Transmission System.

Necessary outages for transmission or generation equipment maintenance must be approved by Big Rivers and should consider unit commitment obligations, other maintenance schedules, and the overall reliability of the transmission system. It may be necessary to coordinate the requested outage with the MISO Reliability Coordinator or neighboring utilities. The connected entity is responsible to ensure all approvals and clearances are obtained and that proper notifications are made in the appropriate time-frame.

Operational Issues

Planning

R3.1.14 Operational issues (abnormal frequency and voltages).

Frequency Variations

Frequency protection must include both an underfrequency function and an overfrequency function. Protection settings must in no instance interfere with the means implemented by Big Rivers to restore system frequency following a disturbance. Frequency protection settings in power plants connected to the transmission system must comply with the steady-state frequency range provided by Big Rivers. Specific acceptable ranges will be determined on a case-by-case basis using accepted industry standards intended to maintain the reliability of the bulk transmission system. However, in general the following ranges apply:

Generator Frequency Range: The connecting entity's generating facility will provide a balanced, symmetrical, three phase interchange of electrical power with the Big Rivers Transmission System at a nominal frequency of 60 Hz. The generation facility must be capable of continuous, non-interrupted operation in the frequency range of 59.5 to 60.5 Hz. Limited time, non-interrupted operation is also expected outside this frequency range in accordance with the generator manufacturer's recommendation.

Transmission System Frequency Range: The Big Rivers transmission system typically operates at a nominal 60 Hz with a variation of +0.05 Hz to –0.05 Hz. Under certain emergency conditions, the transmission system may operate for a period of time outside of this range. The Requester is responsible for providing any frequency sensing equipment required to protect their facility during abnormal frequency operation

Unbalanced Electric Conditions – Transmission/End-User

Voltage unbalance attributable to the connected facilities shall not exceed 1.0% measured at the point-of-service. Voltage unbalance is defined as the maximum phase deviation from average as specified in ANSI C84.1, "American National Standard for Electric Power Systems and Equipment – Voltage Ratings, 60 Hertz." This voltage standard shall be considered during the facility design (prior to connection).

Phase current unbalance attributable to the connected facilities combined generation and load shall not exceed 5% measured at the point-of-interconnection.

Situations where high unbalance in voltage and/or current originate from the transmission system are to be addressed in the Connection Agreement.

Voltage Variations – Generator Connections

Acceptable voltage ranges for use in the design and operation of all facilities connected to the Big Rivers transmission systems are provided in Section 8.0 of this report.

Load Shedding – Operational and Implementation Considerations

Load shedding considerations for the design and operation of all facilities connected to the Big Rivers transmission systems are provided in Section 3.0 of this report.

Relay Coordination to Maintain Stability

Proper relay coordination is necessary to ensure stability. Relay coordination should be considered in both the design and operation of all transmission connected facilities. Specific protection system requirements can be found in Section 4.0.

Generator Connected Through a Tapped Transmission Line

Entities that wish to connect a generator through a tapped transmission line may be required to install additional equipment to ensure the overall stability and reliability of the transmission system. Any such requests will be considered on a case-by-case basis.

Other Applicable Operating Requirements

In order to assure the continued reliability of the Big Rivers Transmission System, the connecting entity may be requested to adhere to other operating requirements and/or encouraged to adopt common operating practices. These include the coordination of maintenance scheduling, performance not to exceed a specified forced outage rate, operations procedures during system emergencies, participation in balancing area operating reserves, provisions for backup fuel supply or storage, and provisions for emergency availability identified by the North American Electric Reliability Council. Big Rivers, as the Transmission Provider, may require the connecting entity to provide generation based ancillary services per the Big Rivers Open Access Transmission Tariff.

Conformance with applicable requirements in NERC Standards and SERC Supplements or guidelines is required. All data reportable to SERC and/or NERC shall also be made available to Big Rivers.

Inspection Requirements for Existing and New Facilities **Planning**

R3.1.15 Inspection requirements for existing or new facilities.

Before a connecting entity owned facility can be energized, it must pass a final inspection by Big Rivers personnel. Big Rivers will inspect all substation equipment from the point of interconnection to the first protective fault interrupting device and the ground system. This may include circuit breakers, circuit switchers, power fuses, instrument transformers, switches, surge arresters, bushings, and relays and associated equipment (including battery and battery chargers). The inspection will consist of a visual inspection of all major equipment as well as review of required test results. In addition, Big Rivers maintains the right to inspect all generator plant facilities prior to synchronizing. The inspections will focus on ensuring all technical, regulatory, and safety requirements have been met. Access to the facility must be provided to Big Rivers to allow the described inspections. The facility owner may be required to modify operations to reasonably comply with the necessary training. However, Big Rivers will coordinate such tests in a manner that minimizes the impact on actual operations.

The connecting entity is responsible for operating its facilities with full regard for the safe practices of, and with full cooperation under the supervision of the Big Rivers Control Center.

Under no circumstances shall a connecting entity energize Big Rivers transmission facilities which have been de-energized. Circuits which are electrically disconnected from the Big Rivers transmission system and are energized by a connecting entity constitute a potential safety hazard for both Big Rivers transmission personnel and the general public. Also, the energizing of such circuits at abnormal voltage or frequency could cause damage to electrical equipment of both the Big Rivers Transmission System and the generation.

Specific minimum requirements for operation of generation on the Big Rivers transmission system follow:

The ground system must be checked by using the resistance measurement procedures in accordance with IEEE Standard 81 "Recommended Guide for Measuring Ground Resistance and Potential Gradients in the Earth."

Prior to the commencement of parallel operation, connecting entity shall obtain the written approval of Big Rivers regarding all protective relay equipment and direct transfer trip equipment it proposes to install for the protection of the Big Rivers transmission system. Prior to granting or denying such approval, Big Rivers or the connecting entity shall inspect and calibrate the system protection facilities in accordance with the relay setting data issued by Requestor. Inspection and calibration must either be performed or witnessed by Big Rivers personnel at connecting entity's expense. Connecting entity shall record the actual settings and inspection data on the relay setting document furnished by Requestor, and return such document for approval, which approval shall not be unreasonably denied if it meets applicable standards. After commencement of parallel operation, Big Rivers shall have the right, but shall have no obligation or responsibility to: i) observe connecting entity's tests and/or inspection of any of connecting entity's system protection facilities; ii) review the settings of connecting entity's system protection facilities; and iii) review connecting entity's maintenance records relative to the facility and/or connecting entity's system protection facilities. The foregoing, rights may be exercised by Big Rivers from time to time as deemed necessary upon reasonable notice to connecting entity. However, the exercise or non exercise by Big Rivers of any of the foregoing rights of observation, review, or inspection shall be construed neither as an endorsement or confirmation of any aspect, feature, element, or condition of the facility or connecting entity's system protection facilities or the operation thereof, nor as a warranty as to the fitness, safety, desirability, or reliability of same.

Normal and Emergency Operating Conditions **Planning**

R3.1.16 Communications and procedures during normal and emergency operating conditions.

The operators of all facilities (generation, transmission, and end-users) connected to the Big Rivers transmission system shall provide a contact person for communications. This contact must have the authority to operate the facilities according to the instructions of the appropriate operating entity (typically Big Rivers).

Voice Communications

Normal – At Big Rivers' request, the connecting entity shall provide a dedicated voice communication circuit to the Big Rivers Control Center.

Such a dedicated voice communication circuit would originate from the connecting entity's office staffed 24 hours a day and would be typically required for generation facility synchronization and operation within Big Rivers' Balancing area.

All other normal voice communication concerning facility operations shall be conducted through the public telephone network to the Control Center phone number(s) issued by Big Rivers.

Emergency – Voice communication in the event of a transmission system or energy emergency shall use the dedicated voice circuits, or public telephone network and phone number(s) designated for emergency use.

In the event of a transmission system emergency, energy emergency, or transmission facility restoration effort, the connecting entity may be notified by the Big Rivers control center. Specific instructions may also be given regarding the operation of the connecting entity's unit(s) depending on the nature of the emergency. These instructions may consist of switching changes, voltage schedule changes, real and/or reactive dispatch changes or other VAR support issues, instructions to shut down or start-up the connecting entity's generating unit(s), and the need to implement emergency communication procedures. It is the connecting entity's responsibility to ensure that the unit operators follow all instructions given by the Big Rivers control center during system emergencies. Connected facilities may be subject to Big Rivers' emergency operating plan that can require interruption of load to deal with generation deficiencies and/or transmission system emergencies. It is noted that interrupting of load will only be done in extreme conditions that would result in a more serious degradation of system performance than if the load were not shed.

It is the connecting entity's responsibility to take prudent steps when an area or system wide capacity emergency is declared. Load reductions shall be implemented by reducing non-essential loads. This type of reduction is usually conveyed through the local media. The End-User is responsible for providing Big Rivers control center a "customer contact list."

These End-Users shall be provided an unlisted phone number to be used for emergency or routine operations to Big Rivers control center. Operational emergencies (equipment) warrant a direct call either way.

Disturbance Monitoring

The connecting entity's facility must have disturbance monitoring equipment per applicable NERC standards and SERC supplements or guidelines.

Requirement 3:
Maintain and Update Facility Connection Requirements **Planning**

R4. The Transmission Owner shall maintain and update its facility connection requirements as required. The Transmission Owner shall make documentation of these requirements available to the users of the transmission system, the Regional Reliability Organization, and NERC on request (five business days).

This document and all referenced Big Rivers documents are available upon request (within 5 business days) and are available on the Big Rivers page of the MISO OASIS.

Prior to MISO membership, Big Rivers Electric Corporation posted the Facility Connections Requirements on the public OATI OASIS. The document has been modified in the past and a complete revision history documenting the changes is included in the document.

Attachment A:

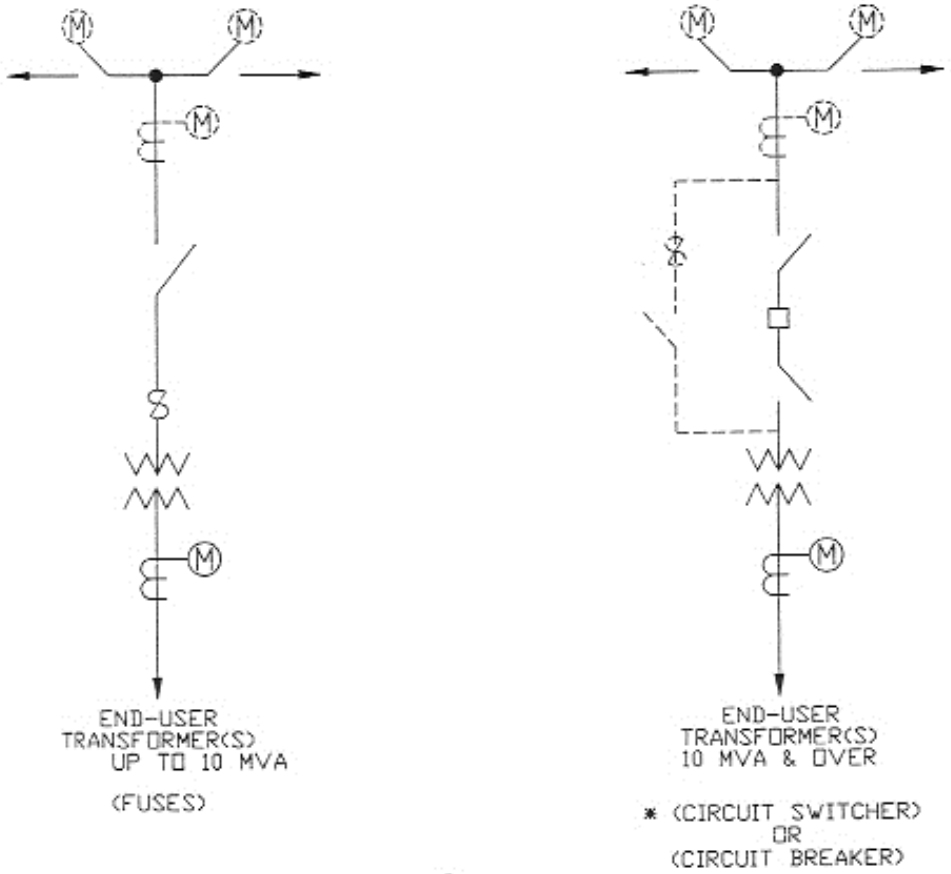
Figure 1 – Typical Transmission Tap Line Supply Configurations (69 kV)

Figure 2 – Typical Transmission Looped Supply Configurations (69 kV)

Figure 3 – Typical Transmission Looped Supply Configurations (138 & 161 kV)

Figure 4 – Typical Transmission Looped Supply Configurations (345 kV)

FIGURE 1. TYPICAL TRANSMISSION TAP LINE SUPPLY CONFIGURATION
(FOR 69 KV)



------ OPTIONAL OR FUTURE — MOTOR OPERATED AIR BREAK SWITCH

METERING IS TYPICALLY INSTALLED ON THE LOW SIDE OF THE STEP-DOWN TRANSFORMER AND COMPENSATED TO THE HIGH-SIDE TO COVER LOSSES.

REV	BY	ENG	DATE	DESCRIPTION
1	JZ	DGC	6-99	DRAWN ON CAD

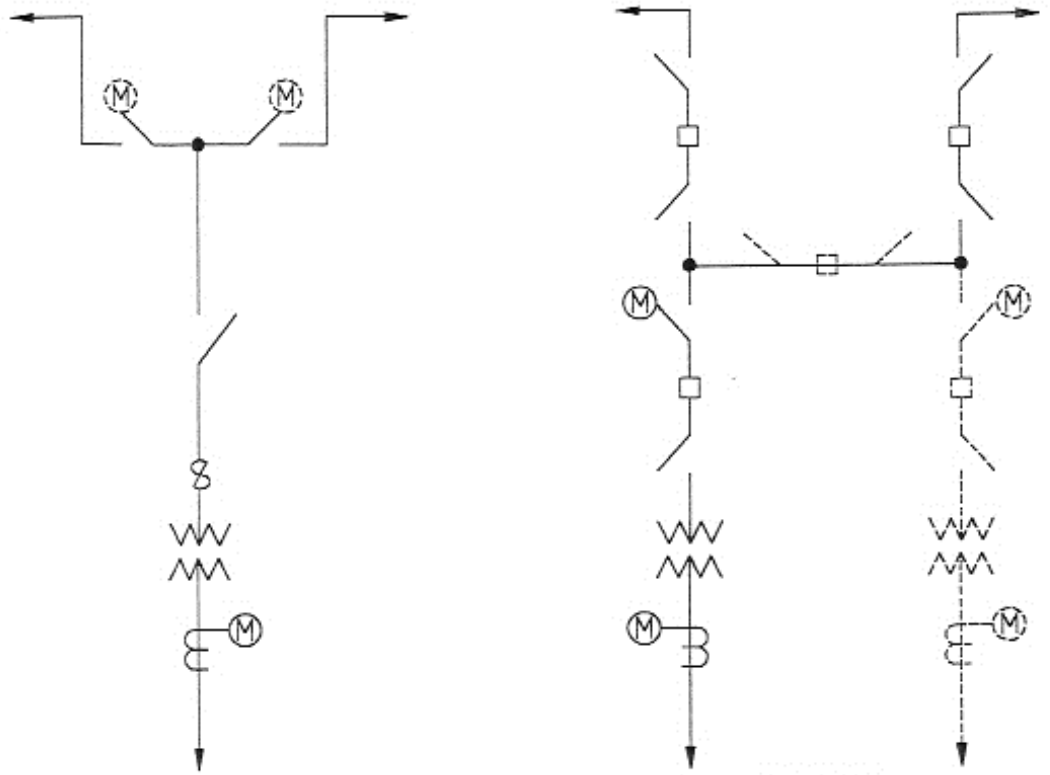
BigRivers Electric Corporation — KENTUCKY — A Touchstone Energy Partner — HENDERSON, KENTUCKY

TYPICAL TRANSMISSION TAP LINE SUPPLY CONF. 69 KV

DWG No. FIG. 1

SEQ | SH 1

FIGURE 2. TYPICAL TRANSMISSION LOOPED SUPPLY CONFIGURATIONS
(FOR 69 KV)



------ OPTIONAL OR FUTURE — (M) MOTOR OPERATED AIR BREAK SWITCH

(M) METERING IS TYPICALLY INSTALLED ON THE LOW SIDE OF THE STEP-DOWN TRANSFORMER AND COMPENSATED TO THE HIGH-SIDE TO COVER LOSSES.

REV	BY	ENG	DATE	DESCRIPTION

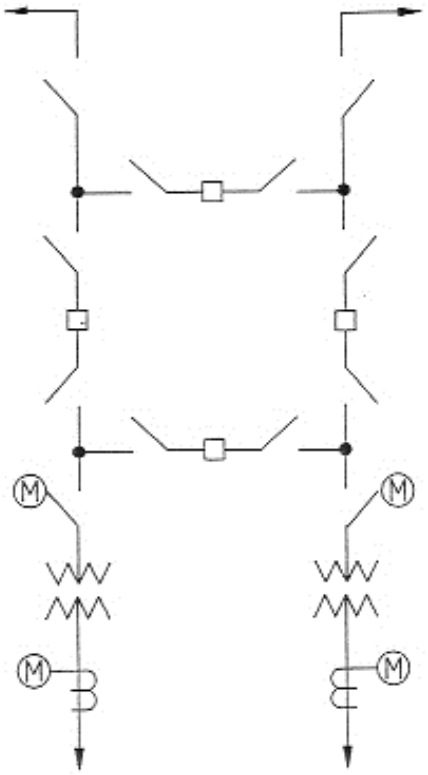
BigRivers Electric Corporation — KENTUCKY KY — A Touchstone Energy Partner — HENDERSON, KENTUCKY

TYPICAL TRANSMISSION LOOPED SUPPLY CONF. (69 KV)

DWG No. FIG. 2

SEQ | SH 1

FIGURE 3. TYPICAL TRANSMISSION LOOPED SUPPLY CONFIGURATIONS
(FOR 138 & 161 KV)



END-USER
TRANSFORMER(S)
10 MVA & UP

------ OPTIONAL OR FUTURE — M — MOTOR OPERATED AIR BREAK SWITCH

— CIRCUIT BREAKER WITH AIR BREAK SWITCHS

M METERING IS TYPICALLY INSTALLED ON THE LOW SIDE OF THE STEP-DOWN TRANSFORMER AND COMPENSATED TO THE HIGH-SIDE TO COVER LOSSES.

REV	BY	ENG	DATE	DESCRIPTION
1	JZ	DGC	6-99	DRAWN ON CAD

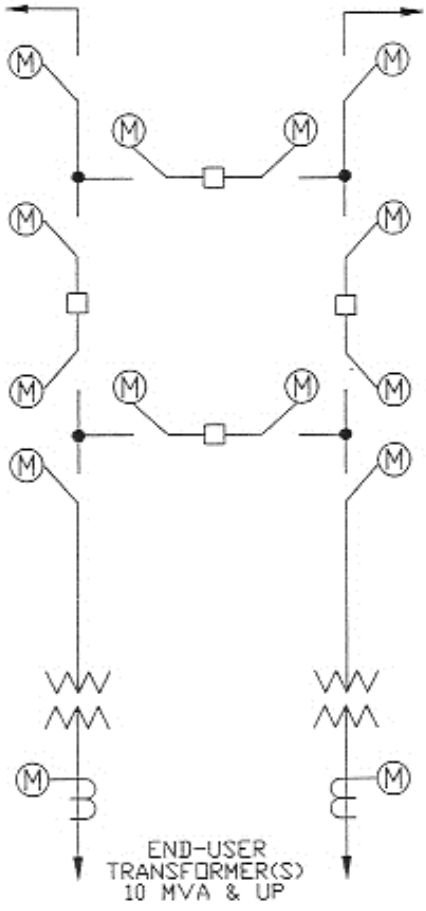
KENTUCKY 82 BigRivers Electric Corporation — A Touchstone Energy Partner — HENDERSON, KENTUCKY

TYPICAL TRANSMISSION LOOPED SUPPLY CONF. (FOR 138 KV & 161 KV)

DWG No. FIG.3

SEQ | SH 1

FIGURE 4. TYPICAL TRANSMISSION LOOPED SUPPLY CONFIGURATIONS
(FOR 345KV)



OPTIONAL OR FUTURE — MOTOR OPERATED AIR BREAK SWITCH

CIRCUIT BREAKER WITH MOTOR OPERATED AIR BREAK SWITCHES.

METERING IS TYPICALLY INSTALLED ON THE LOW SIDE OF THE STEP-DOWN TRANSFORMER AND COMPENSATED TO THE HIGH-SIDE TO COVER LOSSES.

REV	BY	ENG	DATE	DESCRIPTION
1	JZ	DGC	6-99	1

BigRivers Electric Corporation
KENTUCKY 62
A Touchstone Energy Partner
HENDERSON, KENTUCKY

TYPICAL TRANSMISSION LOOPED SUPPLY CONF. (FOR 345 KV)

DWG No. FIG. 4

SEQ | SH 1

Attachment B: Electric Clearances and Equipment Ratings

Nominal System Voltage (kV)	Basic Impulse Insulation Level (BIL) (KV crest) (2)		Outdoor Design Clearance (in.)				Air Insulated Switch Design Clearance (in.)		Station Post Insulated Technical Reference Number (1) (2)
							Air Break	Disconnect	
	Bus & Transformer Winding	Transformer Bushing	To Ground		Centerline-Centerline		Phase Spacing	Phase Spacing	
			Rigid Bus	Strain Bus	Rigid Bus	Strain Bus			
345	1050	1050	99	132	150	180	216	150	316
161	750	750	63	86	86	116	168	86	291,295
138	550	650	46	60	72	84	144	72	286,287
69	350	350	29	36	42	48	84	42	216

(1) The technical reference numbers shown are a widely used identification series for post type insulators. Refer to ANSI Standard C29.9-1983, Table 1, for dimensions and characteristics for each insulator. Higher strength insulators with different technical reference numbers are available and should be used if required.

The ANSI Technical Reference (T.R.) numbers refer to insulators with specific mechanical ratings. Higher ratings may be required or may be adequate according to the duty of the specific application.

(2) Substations in heavily contaminated areas may require a higher insulation level than indicated.

Attachment C: Miscellaneous Requirements

Tap Connection Definition and Requirements

Any connection to the Big Rivers transmission system that requires only the End-User load to pass through the connecting facilities under any condition is considered a tap connection. In general, installing, operating and maintaining in-line facilities will be at the End-User's expense even though these facilities are owned by Big Rivers.

The cost to add or modify facilities at remote locations to integrate the End-User's transmission connection will also be at the End-User's expense to the extent allowed by Big Rivers Open Access Transmission Tariff.

For facilities at 69 kV, Figure 1 in Attachment A illustrates typical tapped line supply configurations and some of the basic connection requirements at the tap location point. The in-line air break switches allow for sectionalizing the line without supply interruption to the End-User and the tap line air break switch can disconnect the End-User without outaging the supply line. Optionally, motor operated mechanisms (with or without supervisory control) can be added to in-line air break switches to minimize the time required for restoration for a failure on the Big Rivers supply line.

Tap connections are typically not employed by Big Rivers on its High Voltage Transmission System (138 and 161kV) nor on its extra High Voltage Transmission System (345 kV) except in a substation. The substation bus connection requirements will be reviewed on a case-by-case basis.

For tap supply configuration, either a delta or ungrounded-wye high side transformer winding configuration is preferred. The installation of a grounded-wye high side transformer could require additional protection facilities and costs to be borne by the End-User.

Looped Connection Definition and Requirements

Any connection to the Big Rivers Transmission System that provides two line extensions to supply the End-User is considered a looped connection. In general, the two line extensions are installed to End-Users Facilities obtaining looped service, not to enable Big Rivers to provide adequate electrical service to any location other than the End-User.

Since some looped connections have the potential to significantly affect the reliability and loadability of the Big Rivers Transmission System, specific design and operational requirements are imposed which may not be required for a tapped connection.

Figure 2 in Attachment A illustrates typical looped supply configurations for below 69 kV and some of the basic connection requirements. For looped supply configurations, either a delta or ungrounded-wye high side transformer winding configuration is preferred for connecting substation transformers.

The installation of a grounded-wye high side transformer winding configuration may be acceptable but could require additional protection facilities and costs to be borne by the End-User.

Figure 3 in Attachment A illustrates a typical looped supply configuration for an End-User connecting to the Big Rivers High Voltage Transmission System (138 and 161 kV).

Figure 4 in Attachment A illustrates a typical looped supply configuration for an End-User's connecting to the Big Rivers EHV System (345 kV). These latter two configurations involve supply substation development, which provide for maximizing supply system reliability by minimizing outage effects.

Network Connection Definition and Requirements

Any connection to the Big Rivers Transmission System that allows bi-directional energy and/or fault current flow between otherwise independent transmission systems is an interconnection. This is considered a special circumstance, which requires a detailed system impact study to determine the acceptability of the proposed transmission interconnection and the specific interconnection requirements. Transmission interconnection requests on the Big Rivers System will be considered on a case-by-case basis. The Interconnection **Requester** will be responsible for reimbursement of the cost for these studies. In addition, the cost of facilities to establish and reliably integrate the new network connection will be at the expense of the **Interconnection Requester** to the extent allowed by Big Rivers' Open Access Transmission Tariff.

Remote Relay Access

Remote relay access is not normally required at tap connected facilities.

For loop or network connected facilities, all digital relays which have the capability of recording system disturbance information and are used for protection of Big Rivers transmission facilities shall be provided with the equipment necessary to allow Big Rivers to remotely retrieve this data via Requester supplied access to the public phone system.

Appendix A: SME List

SME Name	Title	Requirements
Chris Bradley	**Manager Energy Control & Compliance**	**All**